# Upcoming Science Priorities

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**Lake Processes**

Water stored in lakes and reservoirs represents a key term in global and regional water balance studies as well as an important source of water resources. It is expected that SWOT will provide a unique dataset of water storage variations for lakes as small as $(250\ m)^2$. The SWOT community will need to:

- Develop ways to leverage this data to address important scientific questions.
- Determine the locations of lakes likely to be observable by SWOT prior to launch.
- Characterize the potentially important influences on accuracy of SWOT lake storage, including lakeshore characteristics, water surface roughness, lake shape, and water surface height dynamics.
- Develop robust modules for assimilating SWOT measurements of lake water storage into global and regional hydrologic models.

## River Discharge

At continental margins, rivers represent the primary transfer of surface water from terrestrial to oceanic reservoirs, and existing *in situ* stream gauges have characterized mean values for global discharge to the oceans. It is difficult to understand most hydrologic processes at these large scales, however, and current measurements do not adequately capture finer scale patterns of discharge for most of the world. SWOT will provide these measurements for rivers wider than 50-100 m globally. However, the SWOT community must:

- Comprehensively validate discharge algorithms to ensure they function well in a range of different river types.
- Determine how to use data assimilation tools to develop continuous discharge fields from temporally isolated SWOT measurements.
- Determine how to best leverage the resulting datasets to address key science questions related to river processes.

# Integration of SWOT Measurements into Models

While direct observation of surface water storage and fluxes during the lifetime of the SWOT mission will provide new insights into the workings of the hydrologic cycle on seasonal and annual timescales, advances in understanding of climate-scale processes will largely come through integration of SWOT measurements into hydrologic, hydrodynamic, land surface, and climate models.

- More accurate representation of lake and wetland water storage and flux through rivers will improve representation of the water cycle in these models.
- Studies aiming to develop novel ways of assimilating SWOT data into models and studies comparing different modeling frameworks across a range of locations will be necessary prior to launch.

## Wetland Water Surface Elevation, Storage, and Connectivity

Because they are generally vegetated and often have diffuse and ill-defined boundaries, wetland environments will represent complex targets for SWOT measurements. At the same time, because of their critical roles in the global water and carbon cycles, observation of wetlands will likely lead to some of the most important hydrologic science outcomes from SWOT. The SWOT community must:

- Work to improve understanding of SWOT error characteristics in different types of wetlands and to determine the best ways in which SWOT can be used to address interlinked problems of carbon, water, and climate in wetland environments.
- Perform studies that demonstrate how SWOT measurements can be used to assess changing connectivity of wetlands to rivers, lakes, and other water bodies.

# Calibration/Validation

Calibration and Validation of SWOT measurements will require ground-based and airborne measurements at many locations in a wide variety of different environments worldwide.

- Develop novel methods and new partnerships for validating water surface heights, inundation extents, river slopes, water storage in lakes and reservoirs, river discharge, and other relevant SWOT measurements will be critical prior to launch.
- Develop new relationships and leverage existing partnerships with scientists and hydrologic measurement agencies from around the world.

# Water/Land Classification Algorithms

SWOT is the first space-based sensor to use near-nadir Ka-band radar returns to measure water surface elevation and inundation extent. As such, there is remaining uncertainty regarding how to use SWOT returns and ancillary information from SWOT, other sensors, and in situ datasets to most effectively make these measurements

- Use data from AirSWOT, simulators, and other tools to develop robust algorithms for classification of water vs. land in a range of different land cover types.
- Assess how accurately SWOT will detect the presence of water under a range of vegetation types.

## Measurement Phenomenology and Corrections

SWOT will collect data at near-nadir incidences using Ka-band frequencies, where there no extensive experience in interpreting the return signal.

- Characterize the contamination in elevation due to vegetation and topographic layover, as well as providing correction algorithms.
- Explore various phenomena (wet troposphere, snow, rain) that will impact the accuracy of estimated heights.
- Perform studies of the use of SWOT data to optimize measurements of floodplain topography (with and without vegetation).

## Higher Level Products

The SWOT Mission will produce discharge and lake water storage products based directly on SWOT observations and, in some cases, comparatively simple statistical models.

However, additional products that use SWOT measurements in combination with hydrologic, hydrodynamic, land surface, and climate models will also represent important outcomes of the SWOT mission.

Development and testing of these products needs to begin soon.

## SWOT Returns from the Terrestrial Cryosphere

SWOT is required to identify water covered by floating ice. Additionally, it is possible that SWOT will provide useful measurements of snow surface elevation, especially during snowmelt when liquid water is present within the snowpack.

Similarly, SWOT may provide some information on variations in elevation of glaciers and ice sheets, especially in low-slope regions.

These measurements may provide useful information on variations in the cryosphere of importance to understanding of the terrestrial water cycle.